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X-ray local energy spectrum measurement at Tsinghua Thomson scattering X-ray source(TTX)

Yingchao Du*

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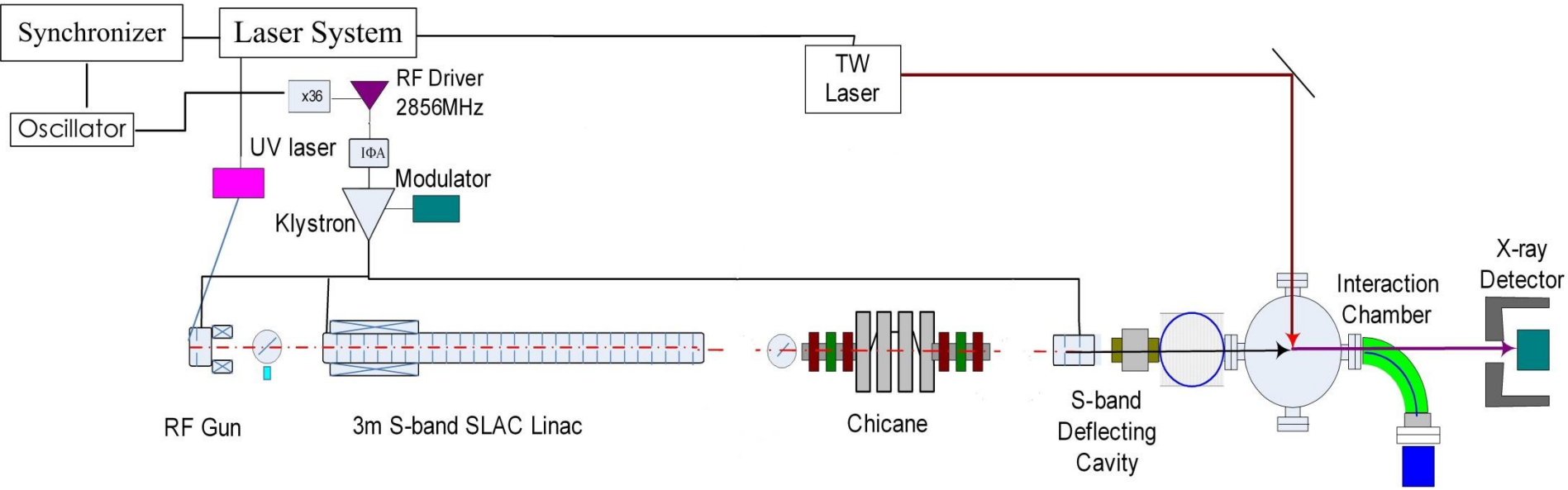
Overview of TTX



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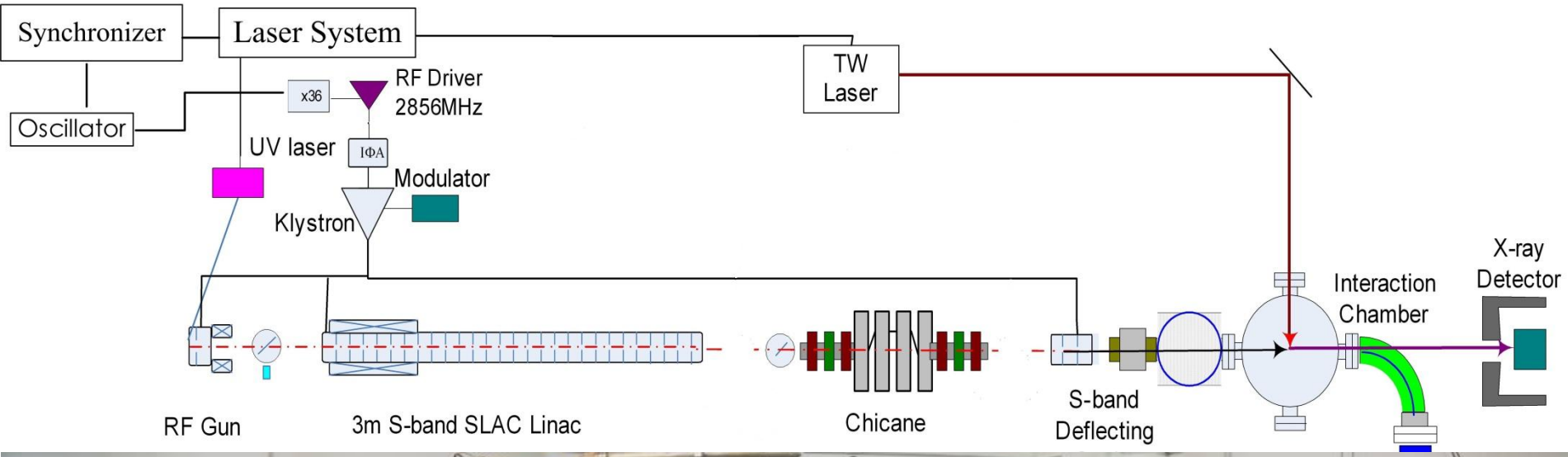

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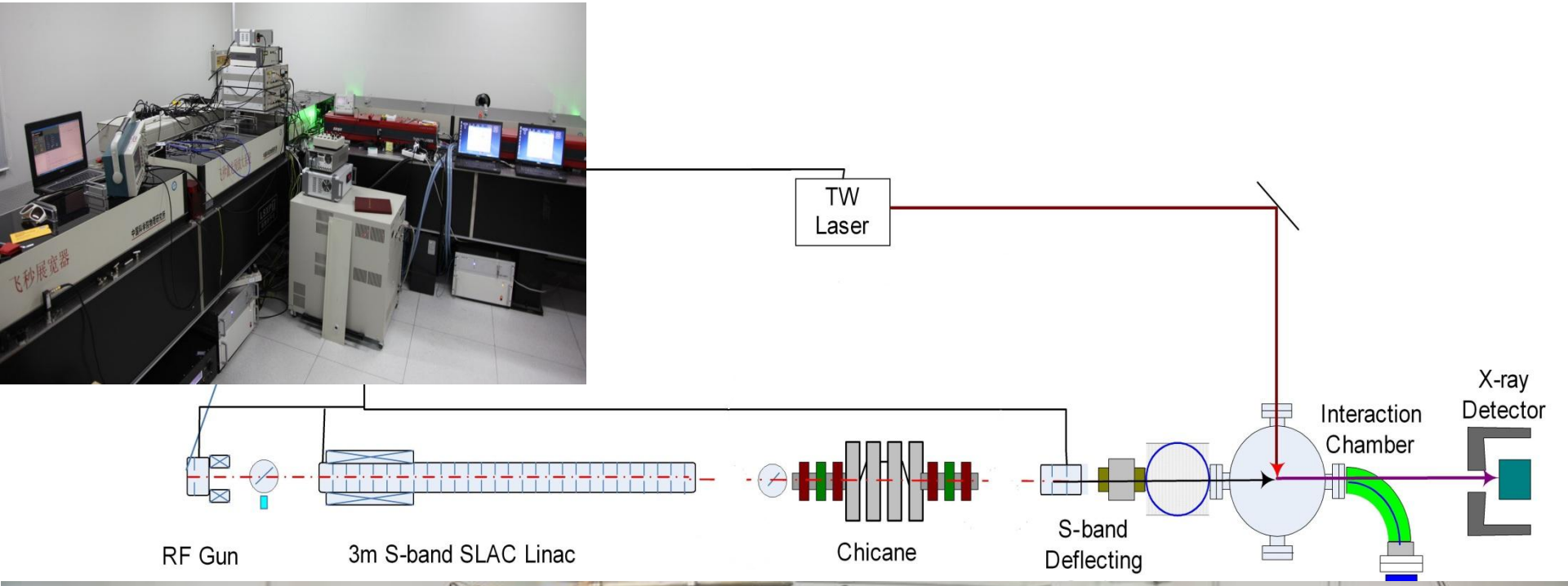

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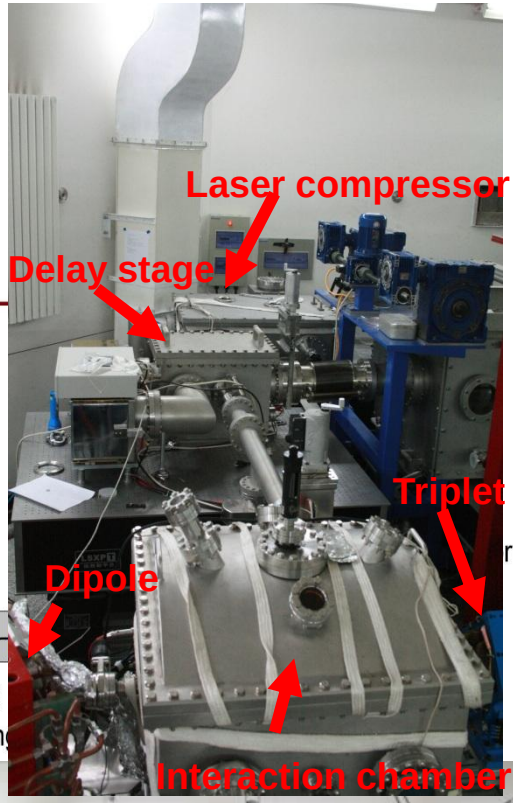

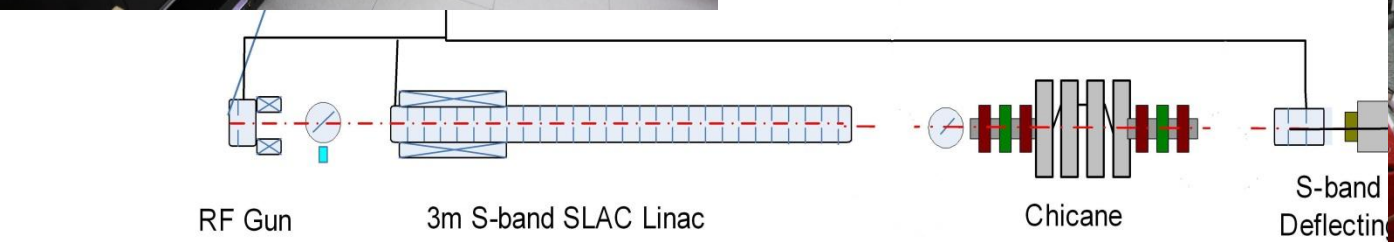

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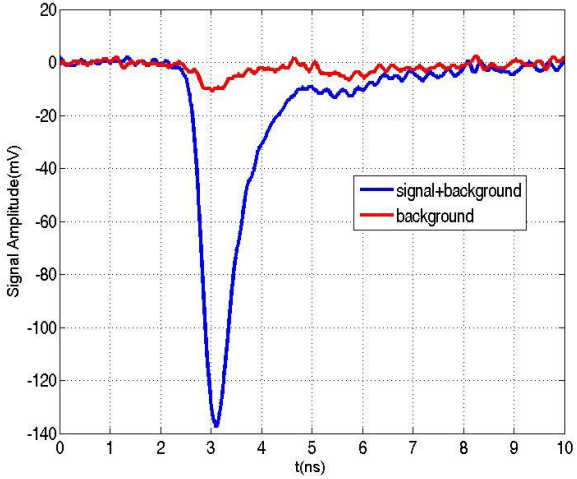

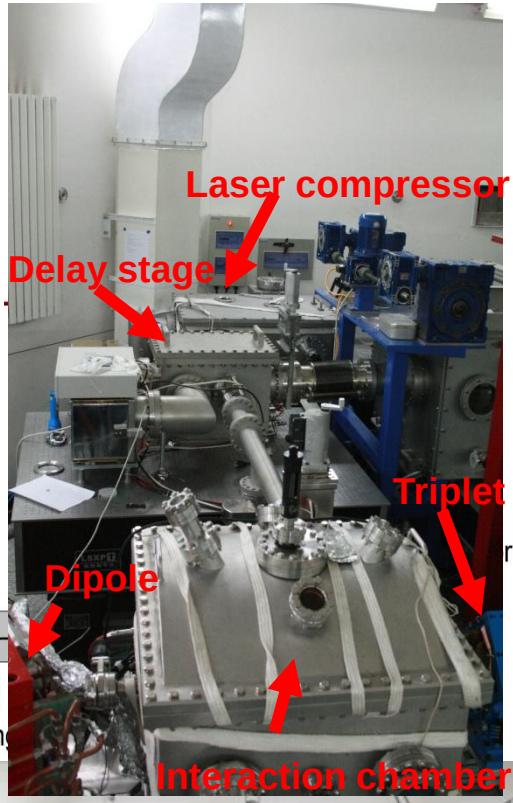

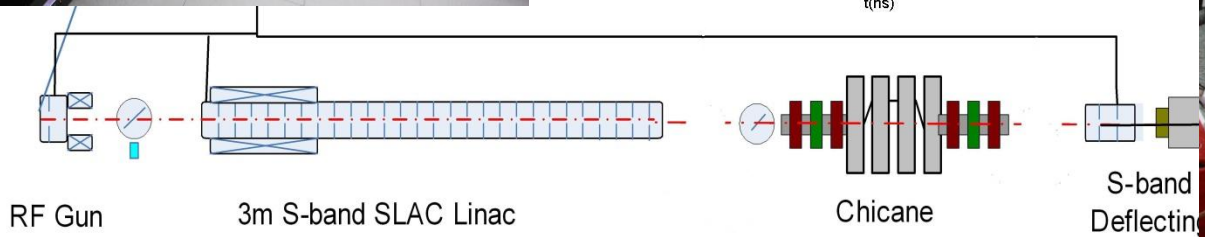

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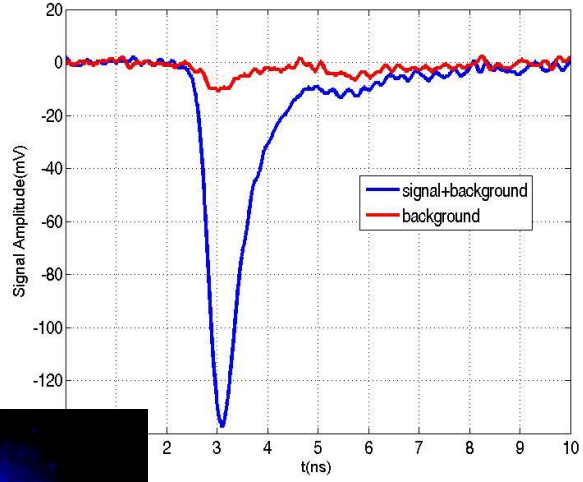

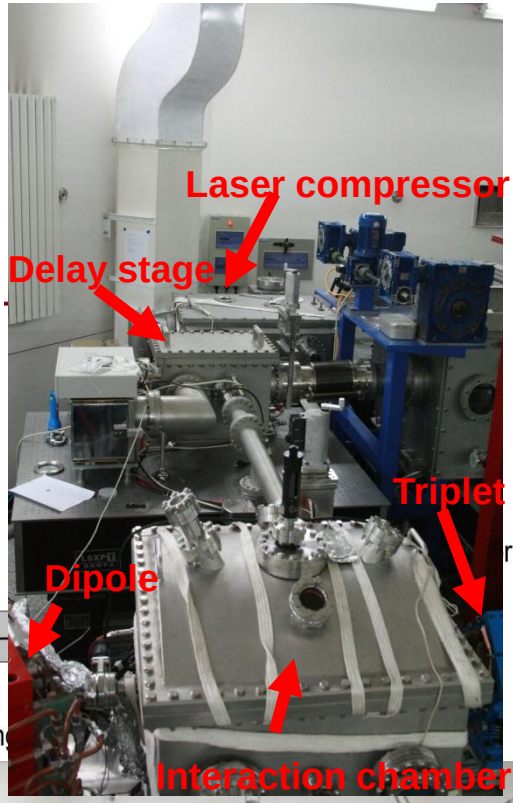

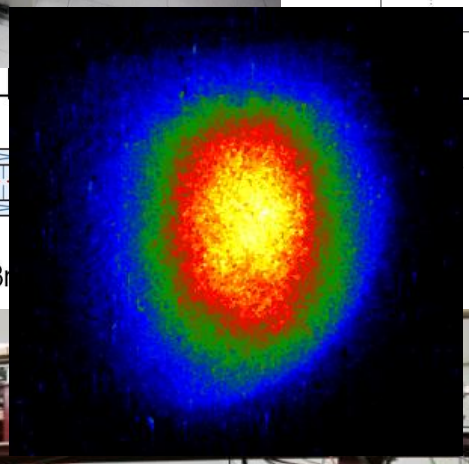

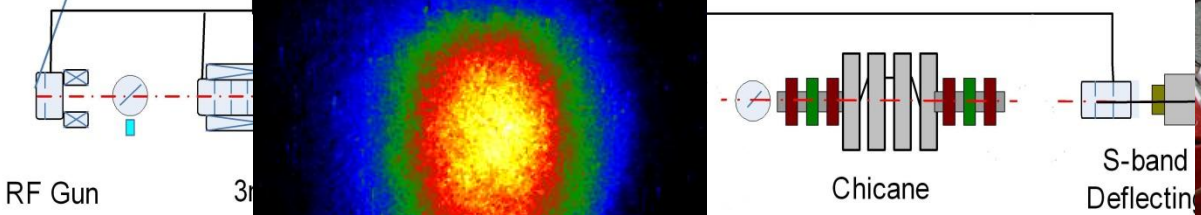

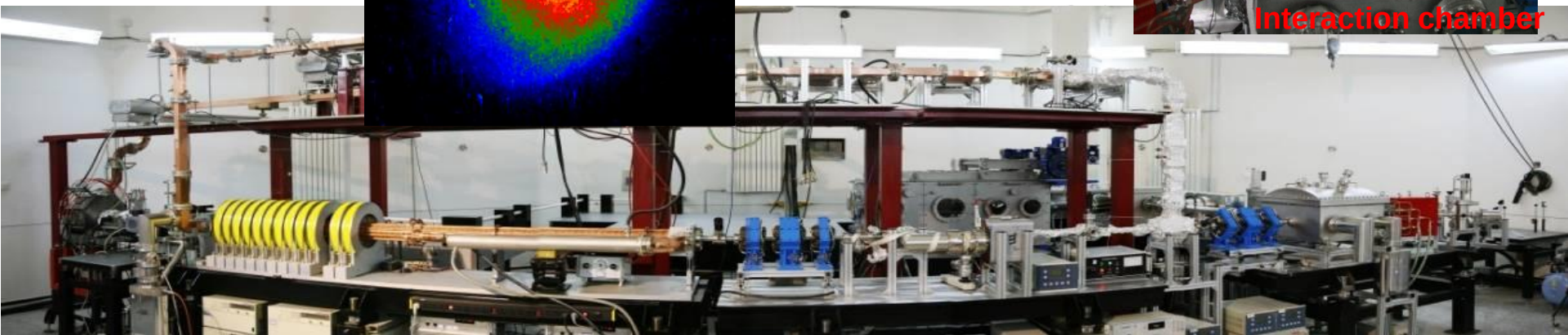

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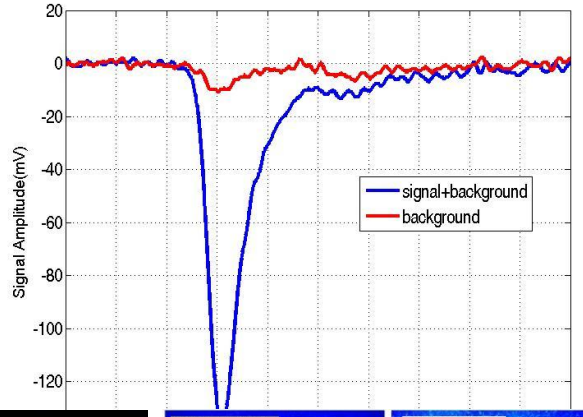
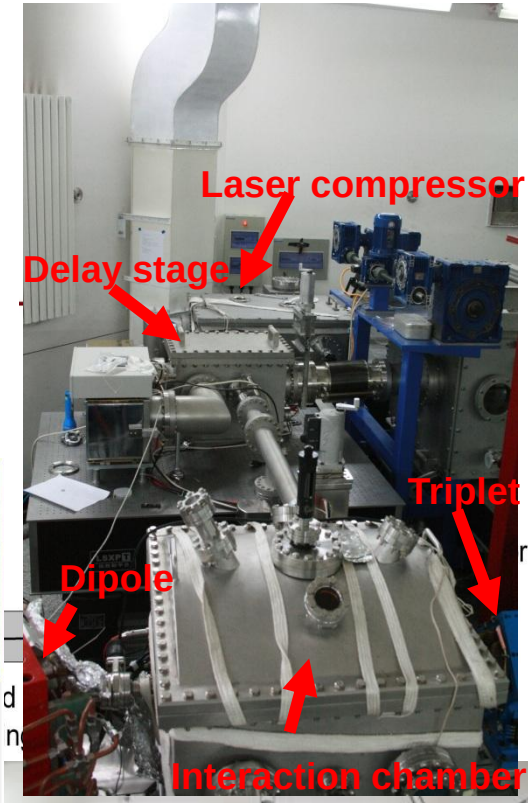
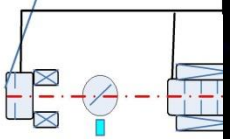
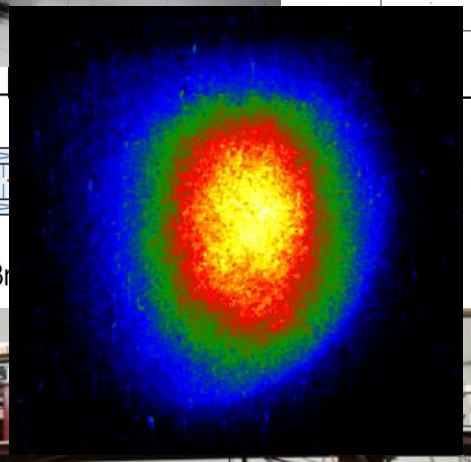
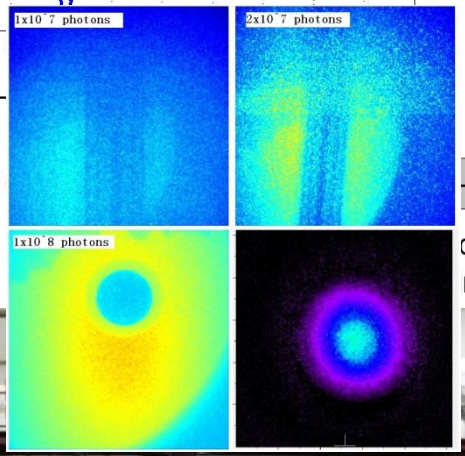


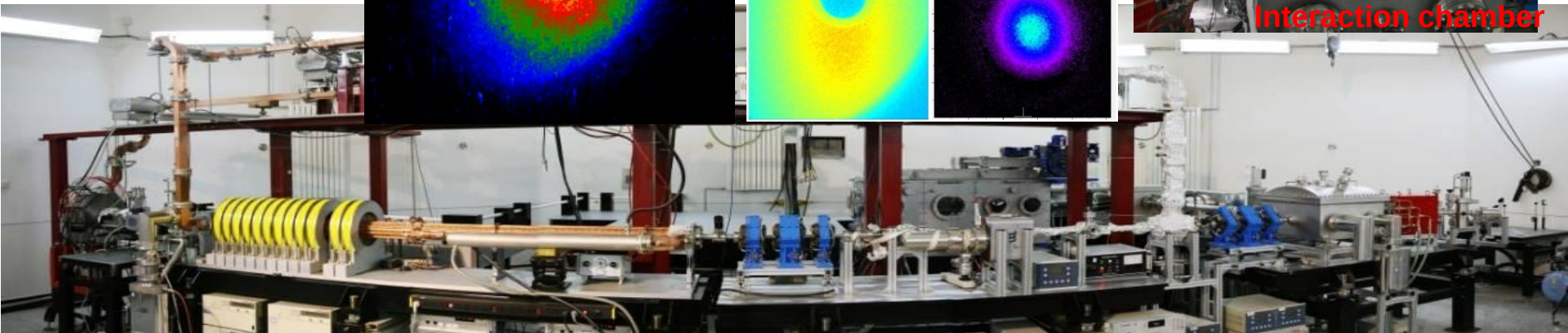




RF Gun







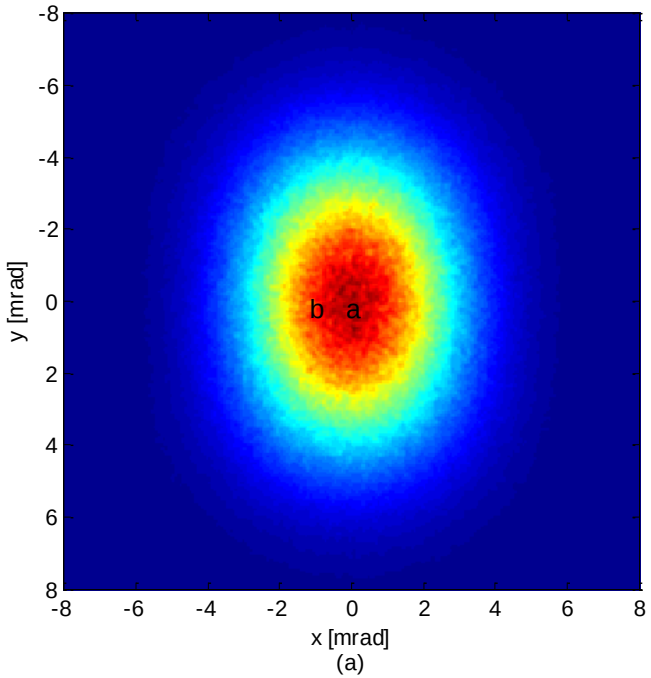
- Spectrum reconstructed from attenuation data
  - The relative transmission function T(x) is related with the spectrum of an X-ray beam:

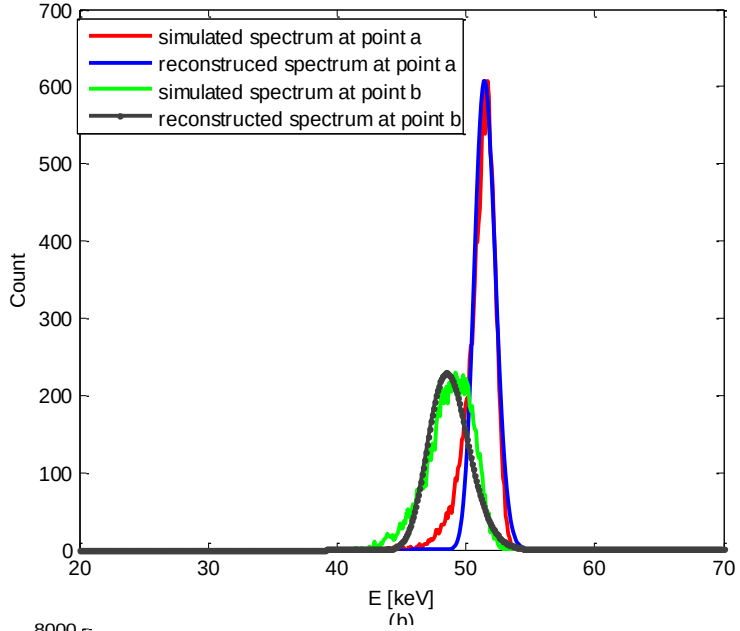
$$T(x) = \frac{S(x)}{S(0)} = \int_0^{E_{\max}} e^{-\mu(E)x} F(E) dE$$

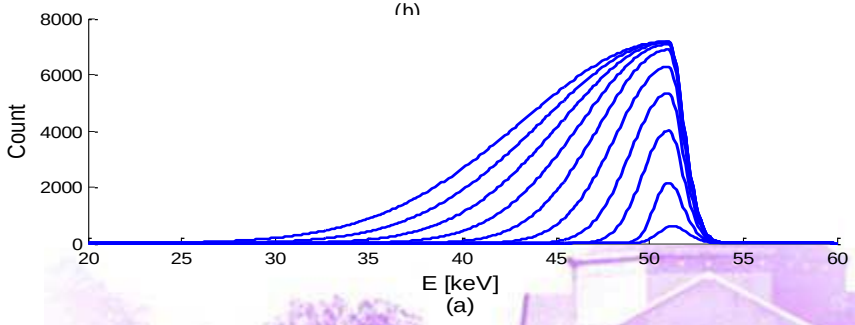
  - Expectation-Maximization algorithm is used to obtain an approximation to the exact solution:

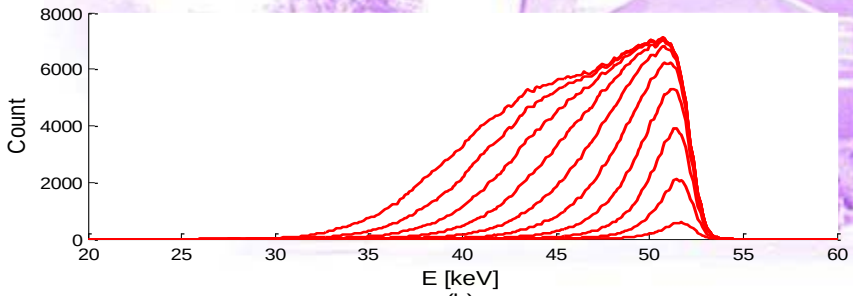
$$F_n^{(k+1)} = F_n^{(k)} f_n, \quad f_n = \frac{\sum_m A_{nm}^t \dfrac{T_m}{\sum_{n'} A_{mn'} F_{n'}^{(k)}}}{\sum_m A_{nm}^t}$$

- Simulation results

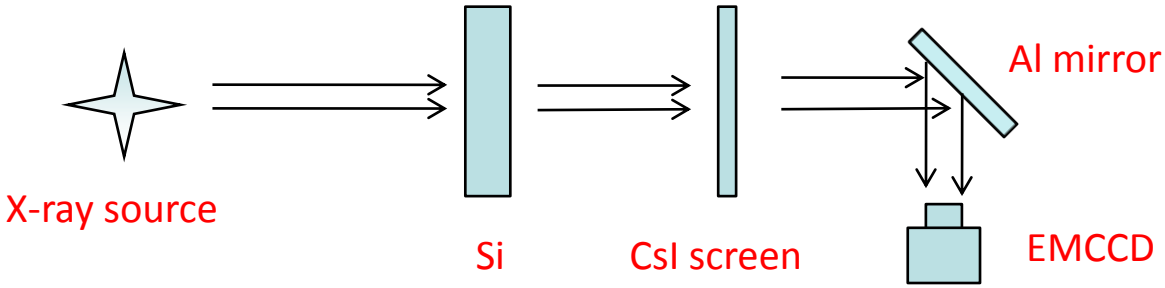








- Experiment setup and result



Exposure time: 20s
Repetition freq: 5Hz

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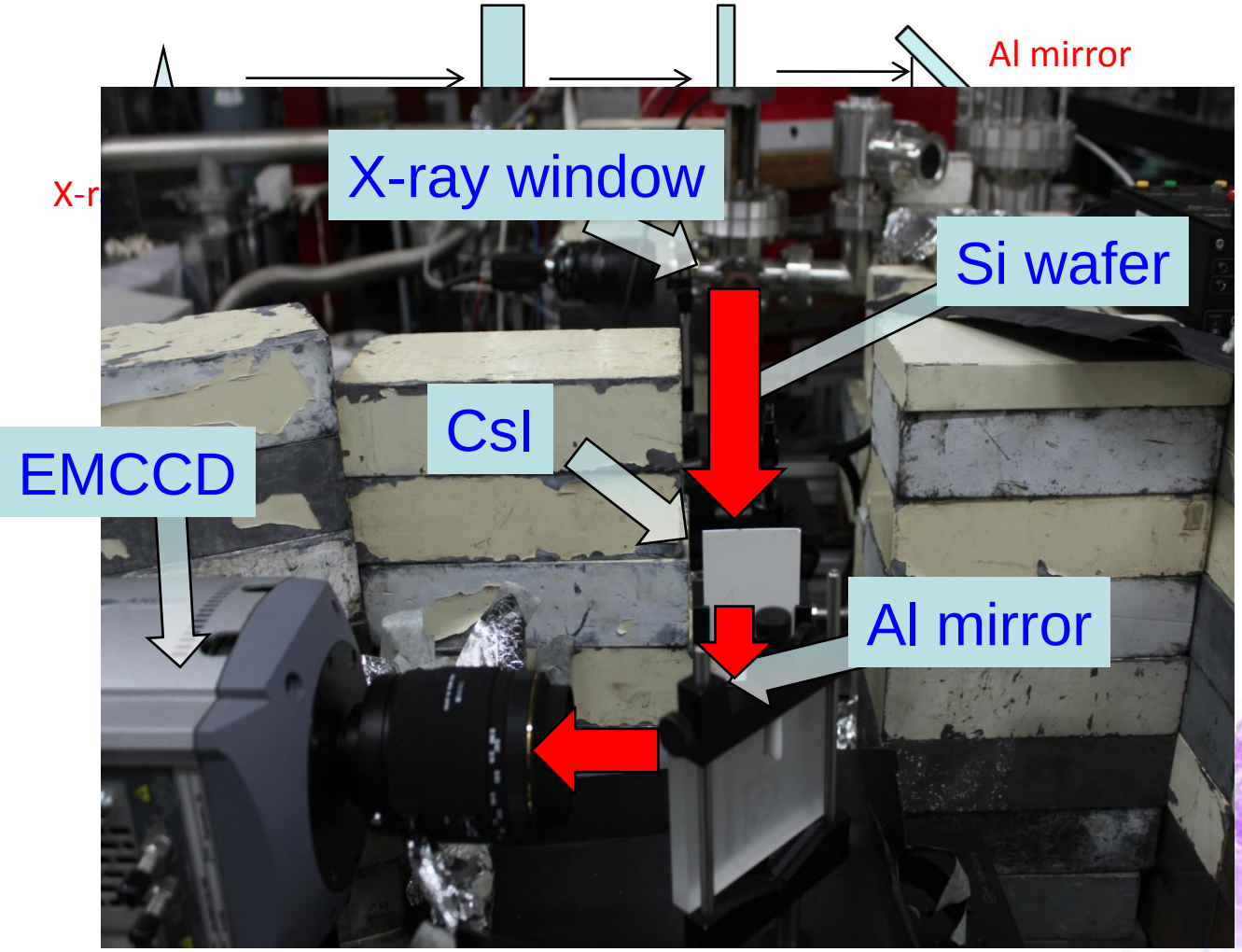

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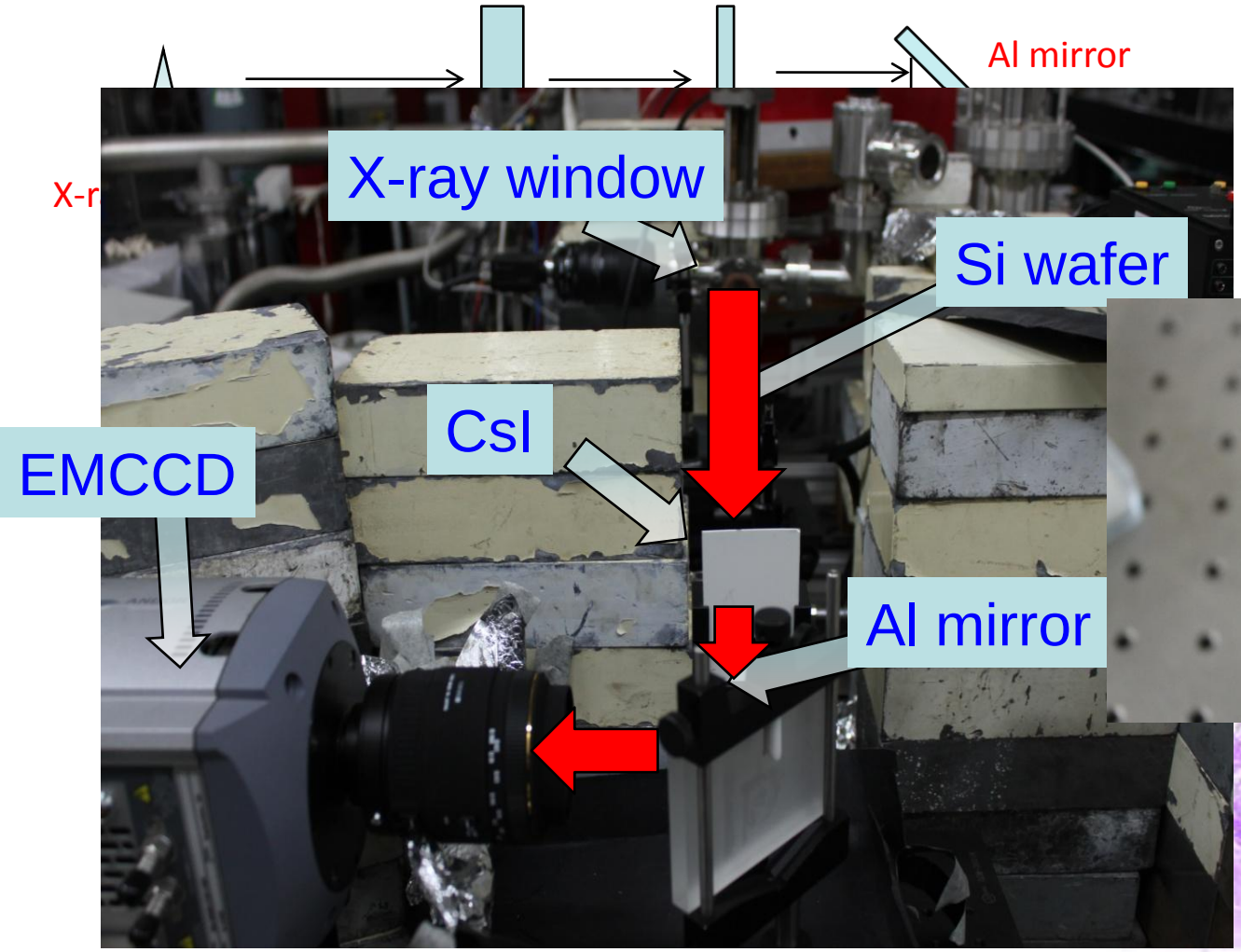

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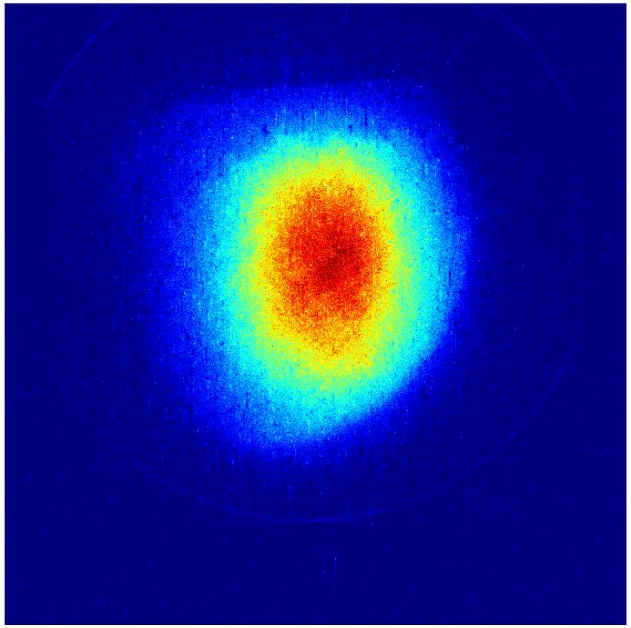
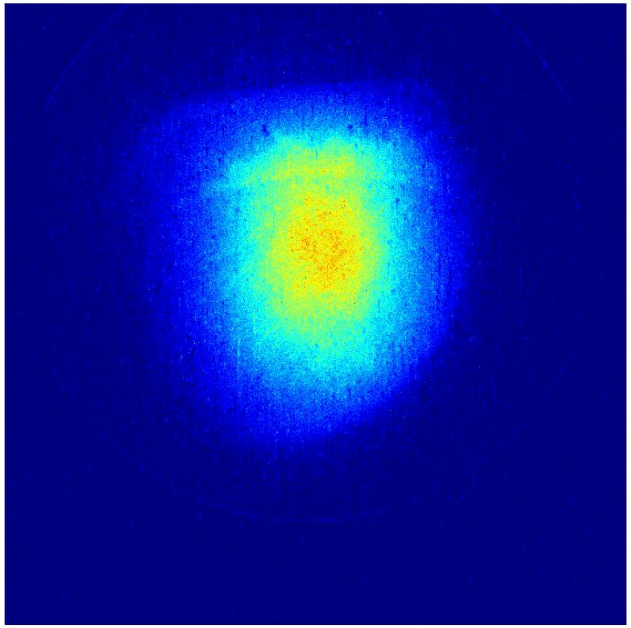
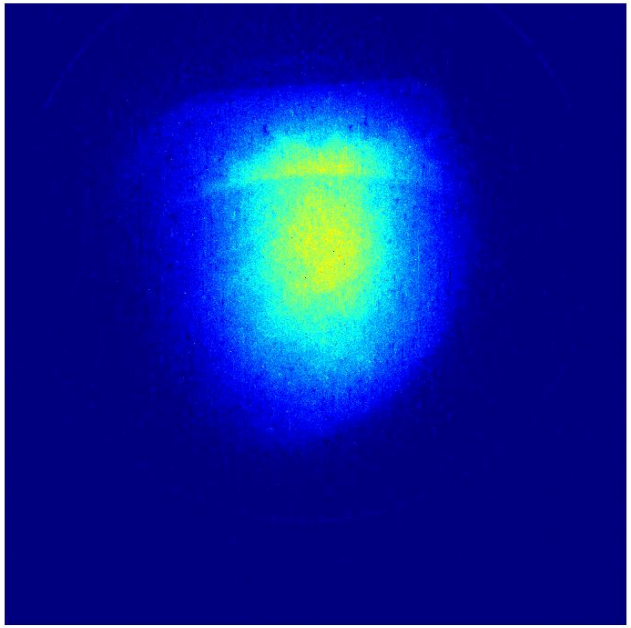
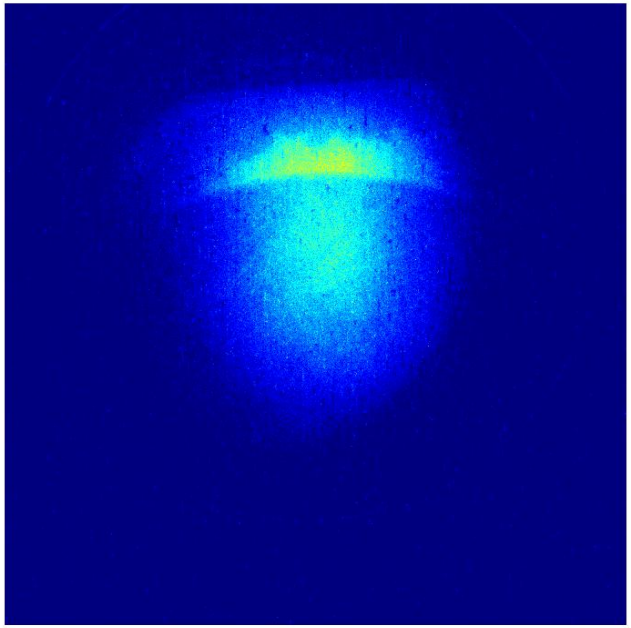
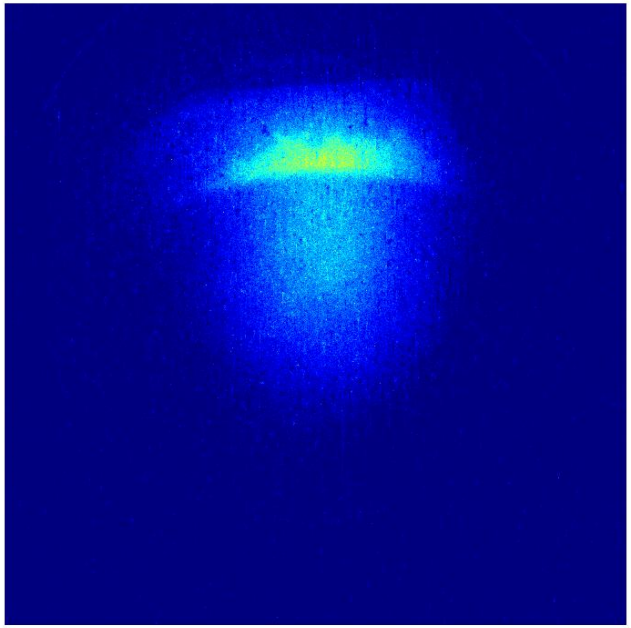
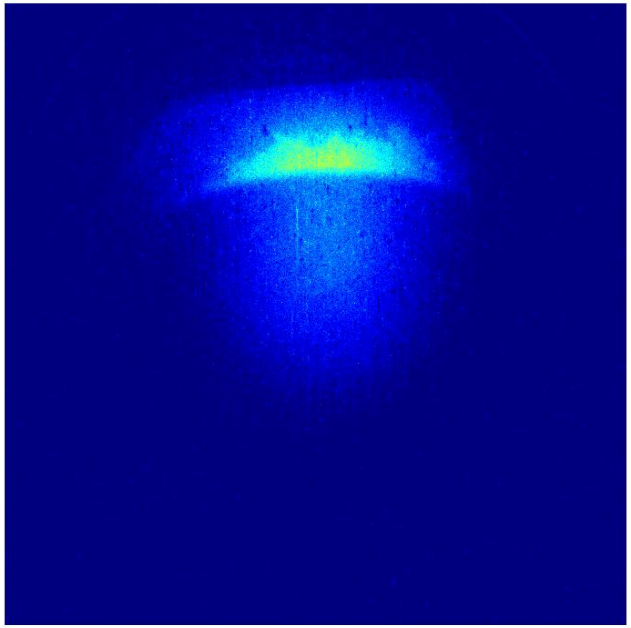


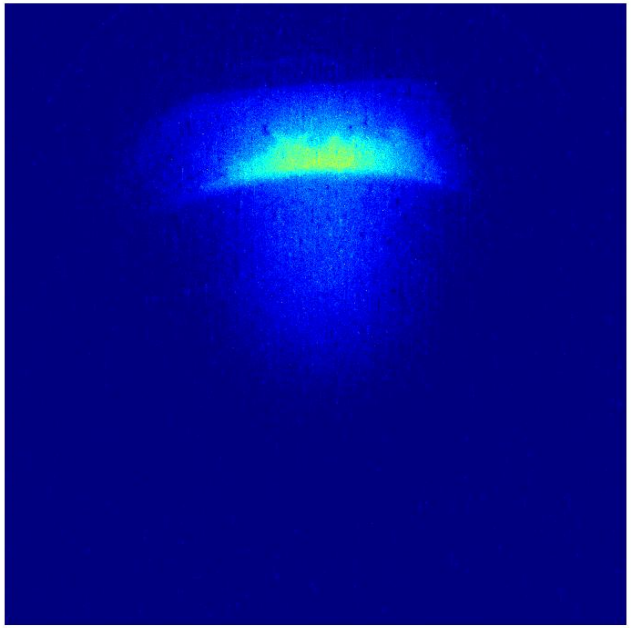


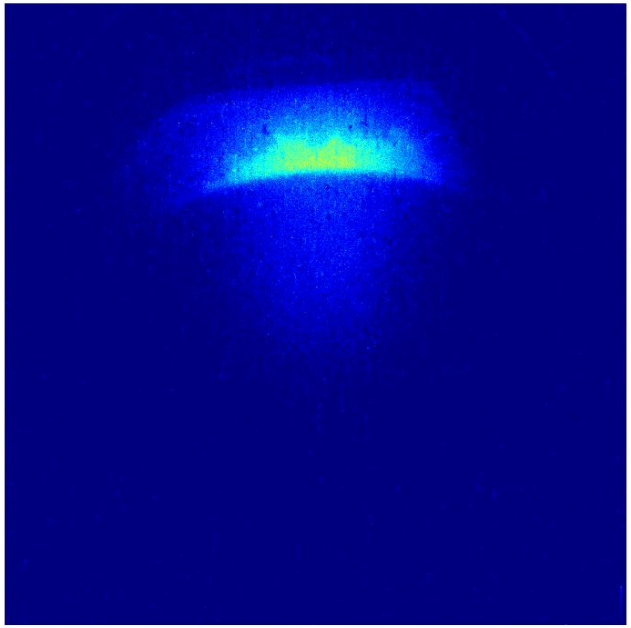


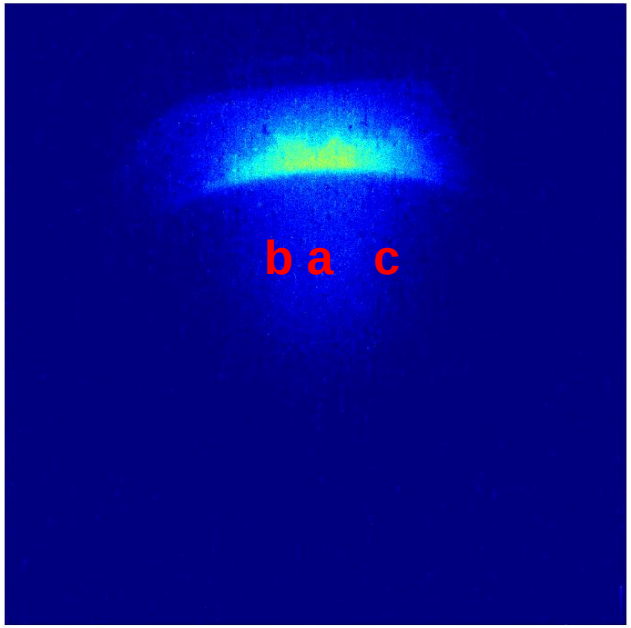


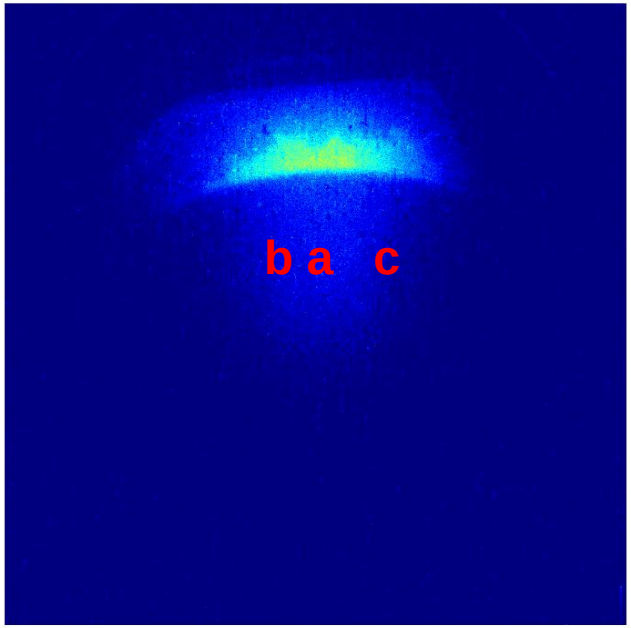









b a c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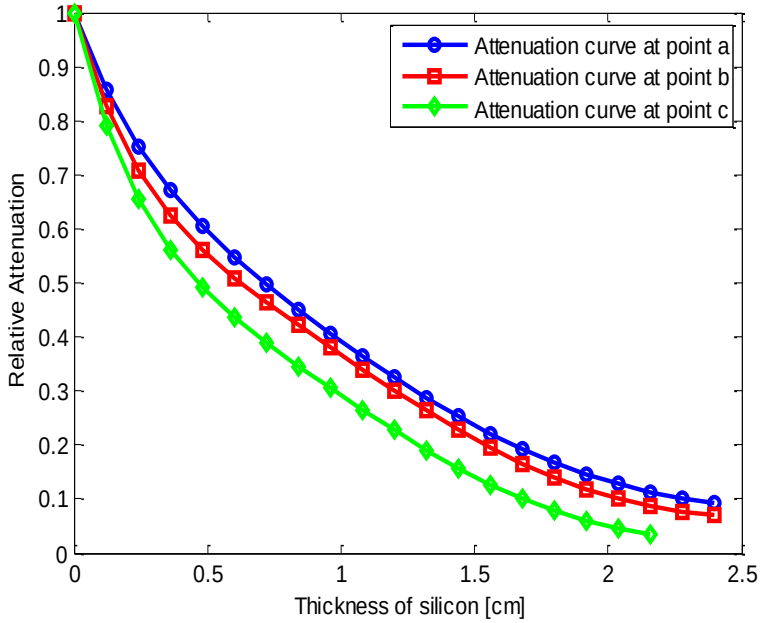
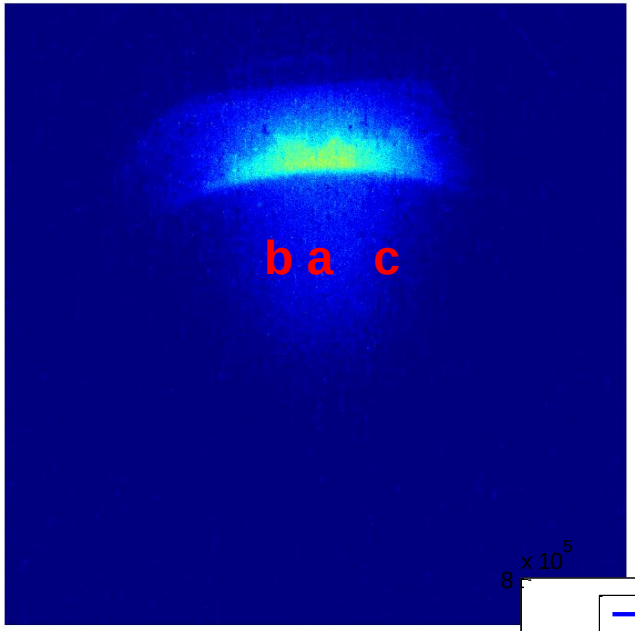
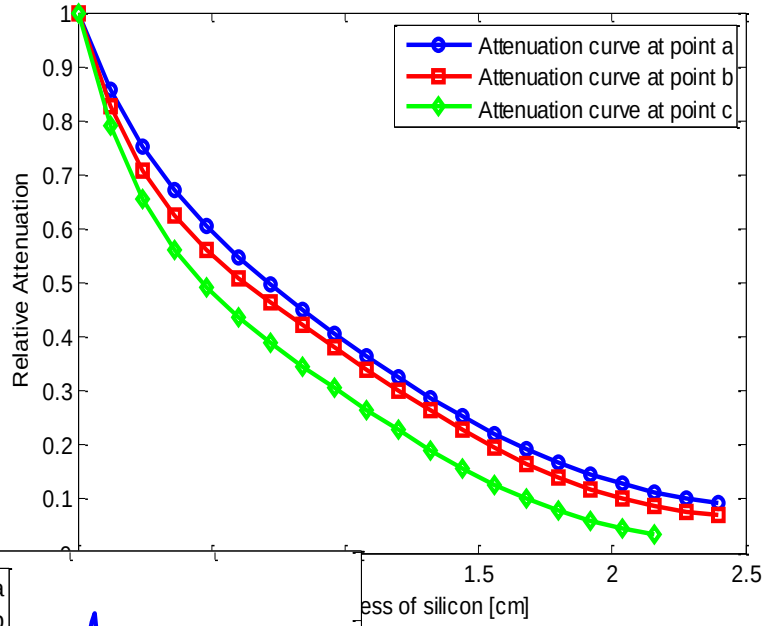
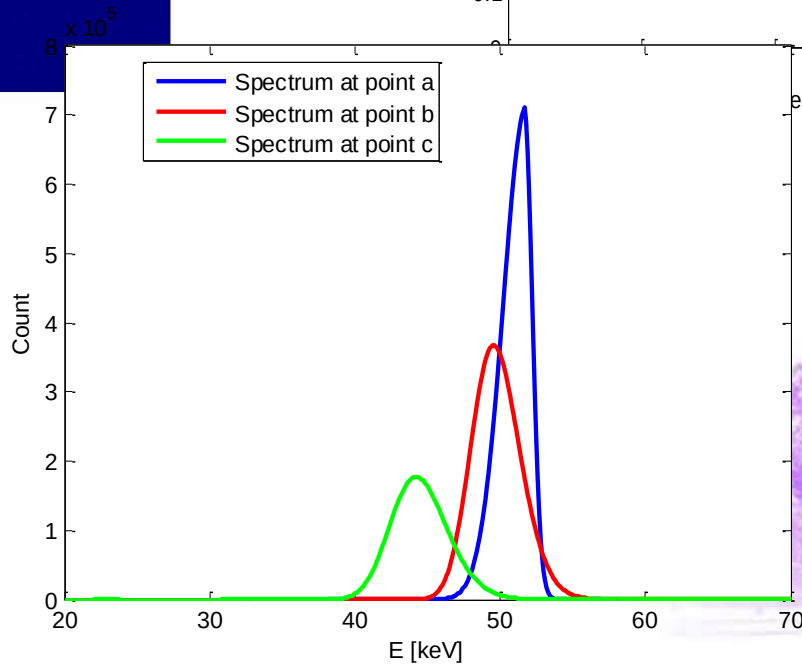
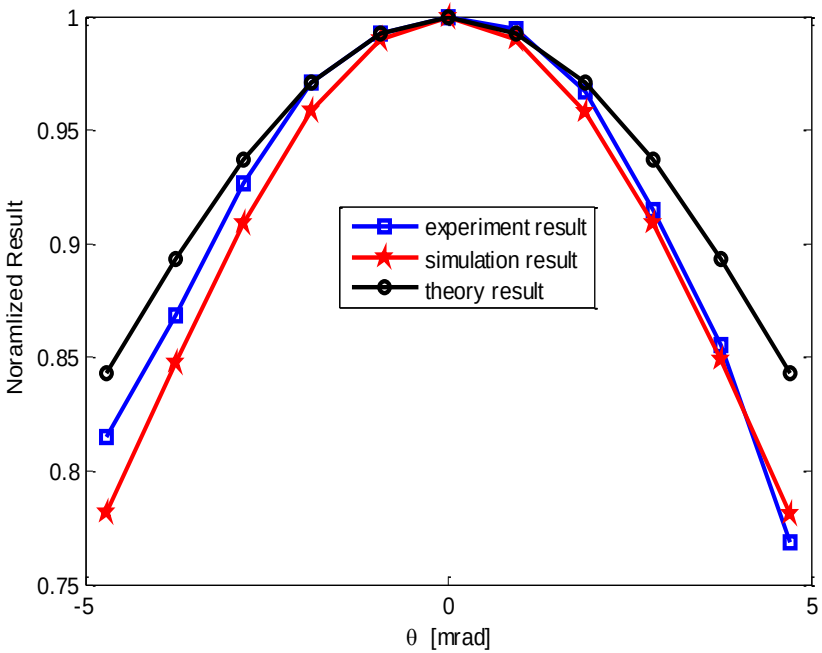

Attenuation curve at point a
Attenuation curve at point b
Attenuation curve at point c
Relative Attenuation
Thickness of silicon [cm]
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.5
1
1.5
2
2.5


b a c

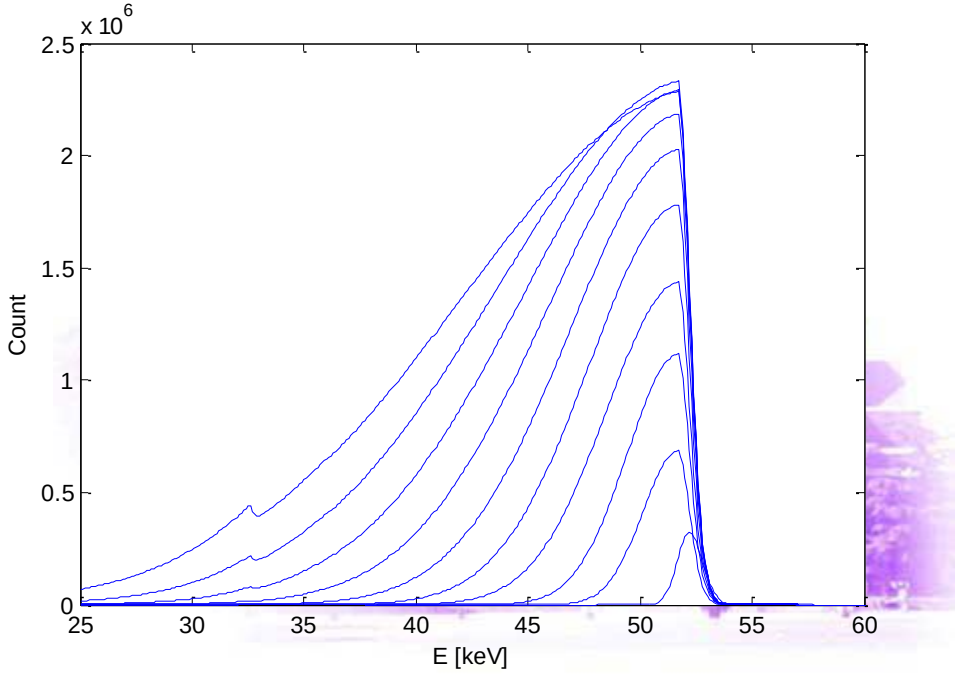

Attenuation curve at point a
Attenuation curve at point b
Attenuation curve at point c
Relative Attenuation
ess of silicon [cm]


x 10^5
Spectrum at point a
Spectrum at point b
Spectrum at point c
Count
E [keV]



Reconstruction spectra results from measured attenuation for collecting angles ranging from 0.5mrad to 5mrad with an equal interval of 0.5mrad. The deposition efficiency of CsI screen is considered.

Mean energy along the line b-a-c in the profile, and compared with theory and simulation.



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